Boltzmann appears to have performed an experiment similar to Fresnel's with inclined mirrors; Trouton has drawn attention to phenomena similar to those of thin plates; and others have experimented with wire gratings like those by means of which Hertz demonstrated the polarisation of electric radiation: but the great wave-length (about half a metre) of the oscillations used has been a stumbling-block in the way of more delicate experiments. Prof. Righi has succeeded in producing oscillations having a wave-length as small as 2·6 cm., and has devised a novel form of resonator made by taking a strip of silvered glass, dissolving away the varnish from the back, and drawing a diamond-line across. He has thus been able to demonstrate the analogy with other phenomena of optics, among which may be mentioned:—Fresnel's interference-experiments with inclined mirrors and biprism; interference by reflection from thin plates and by transmission through them; diffraction by various means (slits, edges, Fresnel's diaphragm); elliptic and circular polarisation; and total reflection. The description of the experiments is accompanied with full theoretical discussions; and if Prof. Righi does not aim at the general treatment which is suitable to a treatise like Poincaré's, he, at any rate, succeeds admirably in showing how the border-land between electricity and optics is being actually explored.

In another memoir,[1] Prof. Righi develops Hertz's equations so as to find the electromagnetic disturbance produced by the combination of two small rectilinear electric oscillations at right angles, say along the axes of z and y, having equal amplitudes but differing in phase by a quarter wave-length. Each of these might be replaced by the mechanical movement of equal and opposite electric charges, oscillating with pendular motion about the origin along one of the axes. Two such mechanical motions at right angles, differing in phase by a quarter wave-length, would compound into a motion of uniform rotation in a circle about the origin in the plane of zy. The disturbance due to such a circular motion of equal and opposite charges would, with certain limitations, be the same as the disturbance produced by the combination of the two rectilinear oscillations first considered. Prof. Righi shows that it takes the form of a spherical wave having its centre at the origin of coordinates. The vibrations are in general (to use the language of optics) elliptically polarised; in the neighbourhood of the axis of x they are circularly polarised; in the equatorial plane zy they are plane-polarised.

In a third memoir, by Prof. H. A. Lorentz,[2] an attempt is made to establish a theory of electrical and optical phenomena in connection with moving bodies. This naturally involves a discussion of the relation between the ether and ponderable bodies in motion, and of the theories proposed by Fresnel and Stokes respectively. After weighing the evidence on both sides, the Leyden professor is of opinion that Fresnel's conception offers fewer difficulties than its rival. The question is of importance in electricity as well as in optics; it is necessarily raised by a rigid examination of any electrical phenomenon, such as the motion of a charged body or of a conductor carrying a current. Prof. Lorentz bases his explanation of electrical phenomena on the hypothesis that all bodies contain small electrically charged particles, and that all electrical processes depend upon the position and motion of these "ions." This conception of ionic charges is universally accepted for electrolytes, and also forms the most probable explanation of the convective discharge of electricity in gases. It is here extended to ponderable dielectrics, the "polarisation" of which is ascribed to the existence of such particles in positions of equilibrium from which they can only be displaced by external electrical forces. The periodically changing polarisations which, according to Maxwell's theory, constitute light-vibrations, here become vibrations of the ions.

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SCIENCE IN THE MAGAZINES.

A MOST interesting account of Madame Kovalevsky's eventful life is contributed to the *Fortnightly* by Mr. E. W. Carter. The sketch is based upon that gifted mathematician's own published recollections, and Madame Edgren-Leffler's biography of her lamented friend. As there are some who are not familiar with the career of the subject of Mr. Carter's article, a short summary of the chief points may be of interest. Sophie Kovalevsky was born at Moscow about 1850, where the first five years of her life were spent. Her father then removed to Palibino, in the government of Vitebsk. It was there that her bent for mathematics first showed itself. A room had been papered with old disused printing paper, amongst which were several sheets of Ostrogradski's lectures on the differential and integral calculus. "This room possessed a strong fascination for the little seven-year-old maiden. Here she was to be found daily, her attention riveted on these walls, striving to understand something of the strange figures and stranger formulas. 'I remember,' says Madame Kovalevsky, 'that every day I used to spend hours before these mysterious walls, struggling to understand some of the sentences, and to find the order of the sheets. By dint of long contemplation, some of the formulas became firmly fixed in my memory, and even the text, though I could comprehend nothing of it at the time, left its impression on my brain.' When several years later, her father was prevailed on to let her have some instruction in mathematics, the results were a surprise and a revelation to all concerned; not least to the little pupil herself. The mysteries of the walls now grew clear, and her progress was made by leaps and bounds. The differential calculus presented no difficulties to her, and her tutor found that she knew the formulas by heart, and arrived at solutions and explanations quite independent of his aid."

In October, 1868, Sophie Kroukovsky contracted the romantic marriage with Vladimir Kovalevsky, and the two went to Heidelberg as students at the University. After two terms spent at Heidelberg, she moved to Berlin, where she worked for four years under the direction of Prof. Weierstrasse, "the father of modern mathematical analysis." During this period, she was occupied in writing the three important treatises which subsequently gained for her the degree of Doctor in Philosophy at Göttingen. Passing over the next few years in Madame Kovalevsky's life, during which her husband died, we come to the winter of 1883–84, when she went to Stockholm as the "Docent" of Prof. Mittag-Leffler. A course of lectures delivered during the winter session led to her appointment to the chair of higher mathematics at the University of Stockholm, in July, 1884, a post which she occupied until her death. The crowning scientific labour of her life was the treatise which gained for her the Bordin prize of the Paris Academy in 1888. The subject proposed was "To perfect in one important point the theory of the movement of a solid body round an immovable point," and in recognition of the extraordinary merits of Mdme Kovalevsky's work, the judges raised the amount of the prize from three thousand to five thousand francs. But the distinguished authoress did not live many years to enjoy the high position she had gained. In February, 1891, she was attacked by an illness which ended fatally after three or four days. So passed away a woman of magnificent gifts, who, "Taking the direction of her life into her own hands, and choosing for herself one of the steepest paths to fame, she traversed it with swift and steady steps."

Mr. W. H. Hudson contributes to the *Fortnightly* an article on "The Common Crow," a bird which he finds from inquiries, "is no longer to be found as a breeder, or is exceedingly rare, in districts where game is very strictly preserved; but that in the wilder counties where game is not strictly preserved, in wooded hilly places, he still exists in diminished numbers as a breeding species." Another article in the same magazine, on "Danish Butter Making," by Mrs. Alec Tweedle, furnishes instructive reading for British agriculturists.

The remarkable growth of electric railroad mileage in the United States, during the past five years, is brought out in an article by Mr. Joseph Wetzler, in *Scribner*. "At the present time," he says, "there are over eight hundred and fifty electric railways in the United States, operating over 9000 miles of track and 23,000 cars, and representing a capital investment of over four hundred million dollars. What stupendous figures, when we consider that in 1887 the number of such roads amounted to only thirteen, with scarcely one hundred cars!" A quotation from a paper in the series on "The Art of Living," contributed by Mr. Robert Grant to the same magazine, is worth giving here. "There are signs that those in charge of our large educational institutions all over the country are beginning to recognise that ripe scholarship and rare abilities as a teacher are entitled to be well recompensed pecuniarily, and that the breed of such men is likely to increase somewhat in proportion to the size and number of the prizes offered. Our college presidents and

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[1] "Sulle onde electromagnetiche generate da duo piccole oscillazioni elettriche ortogonali oppure per mezzo di una rotazione uniforme." (Bologna: 1894).

[2] "Versuch einer Theorie der elektrischen und optischen Erscheinungen in bewegten Körpern." (Leyden: 1895).

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professors, those at the head of our large schools and seminaries, should receive such salaries as will enable them to live adequately. By this policy not only would our promising young men be encouraged to pursue learning, but those in the highest places would not be forced by poverty to live in comparative retirement, but could become active social figures and leaders."

Evolution, and problems belonging to it, crop up periodically as subjects of magazine articles. In the *Contemporary*, A. Fogazzaro, "writer of verses and novels," devotes a number of pages to the polemic battles that have been fought over the evolutionary idea, from the time of Lamarck. "For the Beauty of an Ideal" is the title of his article, which mostly aims at showing how the new wine of evolution may be put into old bottles of Catholic doctrine." A paper on "Evolution and Heredity" is contributed by Dr. G. Symes Thompson to the *Humanitarian*. An introduction to a series of articles on "Professional Institutions," by Mr. Herbert Spencer, appears in the *Contemporary*. The articles will, in their eventual form, constitute part vii. of the "Principles of Sociology."

Two papers in the *Century* call for brief notice. In one, Mr. W. E. Smythe shows how parts of the great arid region to the west of the one-hundredth meridian in the United States have been benefited by careful irrigation. "The work of reclamation has been going forward silently, but gradually and surely, for the better part of a generation. Between ten and twenty millions of acres are now under ditch, and some slight rivulets of population have begun to trickle in upon the lands. But the threshold is scarcely passed. The arid region as a whole comprises more than 800,000,000 acres. Of this empire more than half a billion acres is still the property of the Government." The second paper to which reference has been made, is a short description of three reproductions from photographs of the tree beneath which was buried the heart of Dr. Livingstone. The tree was found near the site of the deserted village of Chitambo, on the south shore of Lake Bangweolo. Upon it, Jacob Wainwright, the Nassich boy who read the Burial Service, chiselled the words, still plainly visible, "Dr. Livingstone, May 4, 1873. Jazuza, Mniasere, Vchopere."

The *Reliquary and Illustrated Archæologist* (April) contains an account, by Mr. Miller Christy, of the exploration of "Deneholes" in Essex and Kent, conducted by the Essex Field Club. Deneholes are ancient artificial caverns in the chalk, having deep, narrow, vertical entrances. They are found in various parts of England, but especially along the banks of the Thames, in Essex and Kent. Mr. Christy has explored many of them, and his opinion as to their origin is—"On the whole, the only conclusion which it seems as yet safe to arrive at is that the mystery surrounding the origin of the Deneholes and the purposes of their makers still constitutes one of the most interesting and perplexing problems yet remaining unsolved in British archæology, perhaps we may say in prehistoric British archæology."

Mr. A. Symons Eccles, in the *National*, writes on "Headaches," and, in the course of his paper, gives the opinion of a distinguished neurologist, that almost every man of science of distinction in London suffers from sick-headache, or migraine, on account of excessive intellectual activity. Mr. Eccles says if they "will sit down to dinner in a state of nervous exhaustion, or do brain work directly after taking food, they can hardly hope to escape from an attack of migraine." In the same review, Miss Balfour concludes the account of her journey through the British South Africa Company's territory, in 1894.

A brief notice will suffice for the other articles in the magazines and reviews received by us. A previously unpublished paper of Richard Jefferies' appears in *Longman's Magazine*, and also a poem by the late Dr. G. J. Romanes. In the *English Illustrated*, the articles from which natural knowledge may be gathered are "Mountaineering in Westmoreland," by Mr. J. F. Fraser; "Stalking the Haplocerus in the Selkirks," by Mr. W. A. Baillie-Grohman; and a "Moorland Idyll," by Mr. Grant Allen. In the *Quarterly Review*, the recently published biographies of Buckland and Owen are used as the basis for an article on advances in the science of biology during this century. *Good Words* contains a short illustrated paper on the Dandelion, by Dr. Hugh Macmillan, and one on "The Sea Birds of the Cape," by the Rev. W. Greswell. Another readable article on birds is Mr. C. J. Cornish's "Birds of the Cliffs," in the *Sunday Magazine*. *Chambers's Journal* has the usual complement of instructive articles on more or less scientific topics. Finally, the *Phonographic Quarterly Review* contains contributions by Dr. W. R. Gowers and Sir Henry Howorth.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Term is now in full swing, and the usual courses of lectures are being delivered in the various departments of Natural Science. The changes from last Term's list are, that Sir J. Conroy and Mr. Frederick Smith have returned to Oxford, and are lecturing on Radiation and Mechanics, respectively, at Balliol and Trinity Colleges. In the Physiological Department, Prof. Gotch has begun his duties as Waynflete Professor, and is lecturing on Mondays and Tuesdays on the Physiology of the Central Nervous System.

Mr. H. Balfour, Curator of the Pitt-Rivers Museum, has been seriously ill, and is absent from Oxford for this Term, being obliged to go abroad for the sake of his health.

In a Congregation, held on Tuesday, May 7, the proposed Statute on Research Degrees was again under discussion, having reached what is technically known as the twelve-member amendment stage. The House reaffirmed by the narrow majority of 39 against 37, the clause which was passed by a large majority last Term, which states that Science shall be held to include Mathematics, Natural Science, Mental and Moral Science. Other clauses, mostly of consequential importance, were added or rejected, amongst them being one of some importance to intending Candidates, which allows residence in the Vacation to count towards the residence of eight terms required by the Statute.

In the same Congregation, Dr. E. B. Tylor, Reader in Anthropology, was constituted Professor in Anthropology during the tenure of his office as Reader in Anthropology.

The seventh summer meeting of University Extension and other Students will be held this year in Oxford. The meeting, as in previous years, will be divided into two parts: the first part will last from Thursday evening, August 1, to August 12, the second from August 12 to August 26. There will be lectures during both parts of the meeting on Natural Science, with classes for practical work. Among the lecturers will be Prof. Green, Prof. Odling, Dr. Kimmins, Dr. Fison, Mr. Carus-Wilson, Mr. J. E. Marsh, Mr. P. Groom, Dr. Wade, and Mr. G. C. Bourne.

The fourth "Robert Boyle" lecture of the Oxford University Junior Scientific Club will be delivered by Prof. Crum-Brown, F.R.S., on Monday next. His subject will be "The Relation between the Movements of the Eyes and the Movements of the Head."

CAMBRIDGE.—Mr. W. G. P. Ellis, of St. Catharine's College, has been appointed a Demonstrator in Botany.

Applications for permission to occupy the University's tables at the Naples Zoological Station, and the Marine Biological Laboratory at Plymouth, are to be sent to Prof. Newton, Magdalene College, by May 23.

The Syndicate for Advanced Study and Research have proposed new statutes for carrying out the scheme recently approved by the Senate, and have extended the scheme so as to include advanced students in law who are graduates of other Universities.

The honorary degree of Doctor of Science is to be conferred on Mr. Francis Galton, F.R.S.

MR. A. E. TUTTON has been appointed Inspector of Schools and Classes under the Science and Art Department.

THE Report of the Council of the City and Guilds of London Institute, upon the work of the Institute during the year 1894, has just been issued. The Council expressed their satisfaction at the renewal of the contribution of the Corporation of London to the funds of the Institute. Special subscriptions have been received, or promised, from the Salters' Company, in addition to their annual subscription, for the encouragement of chemical research; from the Cordwainers' Company, in addition to their annual subscription to the Institute, and the Leather Trades' School, for the inspection of classes in boot and shoe manufacture in connection with the Technological Examinations Department, and, for the first time, from the Tylers' and Bricklayers' and the Coachmakers' Companies. The proposal of the Salters' Company to place at the disposal of the Institute a sum of £150 a year to be applied to founding one or more Fellowships, to be entitled the Salters' Company Research Fellowships for the encouragement of higher research in Chemistry in its relation to manufactures, has already been referred to in these columns. The scheme for the

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